II. Operations and Maintenance

The following section relates to the age, condition, and capacity of individual facilities. The first part of this section is related to any groundwater systems and the second part relates to surface water systems. If the system uses groundwater (well water) exclusively, complete only section A. If source water is taken from surface supplies (streams, lakes, impoundments, rivers, etc.) or from groundwater supplies that have been determined to be under the influence of surface water, complete only section B. If both groundwater and surface water sources are used, complete both sections.

A. Groundwater Systems

1. *Basic System Information*

Complete the following chart with information about each well used by the system. If the system has more than four wells, copy this page and complete the chart for all wells.

	Well __	**Well __**	**Well __**	**Well __**
Source Physical Components				
Age				
Casing type (single or double and material type)				
Casing diameter				
Depth				

	Well __	**Well __**	**Well __**	**Well __**
Source Physical Components (cont)				
Screened (yes or no) / type				
Source water aquifer - confined or unconfined?				
Water Quality				
Potential contamination sources (yes or no) or subject to flooding (yes or no)?				
Source water protection plan? (yes or no)				
Wellhead protection program? (yes or no)				
Under the influence of surface water? (yes or no)				
Raw water quality concerns (list)				

	Well __	Well __	Well __	Well __
Water Quantity				
Daily permitted withdrawal				
Actual yield				
Daily permitted withdrawal divided by actual yield **(Divide average daily production from all wells by total permitted withdrawal. If the answer is greater than 0.9 (that is, actual yield is greater than 90 percent of permitted withdrawal) then additional sources, or more liberal withdrawal permits, may need to be obtained.)**				
Drawdown testing program (yes or no). If yes, frequency?				
Treatment Systems				
Types of treatment currently provided (list)				
Additional or other treatment required (list)				
Age of major components and expected lifespan (design life)				

	Well __	Well __	Well __	Well __
Treatment Systems (cont)				
Capacity (GPM or MGD)				
Does treatment capacity meet highest demand (yes or no)?				
Treatment process produces finished water in 100% compliance with SDWA (yes or no)? If not, why not?				
Are written Standard Operating Procedures available for all treatment processes?				
General condition of treatment system: • Corrosion? • Leaks? • Electrical or mechanical defects?				
Treatment plant subject to flooding? (yes or no)				

	Well __	Well __	Well __	Well __
Treatment Systems (cont)				
Noted safety hazards				
Adequate containment provided for chemical spills (yes or no)?				
Adequate alarms available (e.g., alarm recording telephone or SCADA)?				
Recent major maintenance performed. Indicate type (e.g., preventive, corrective, emergency) and date performed.				
Rehabilitation or maintenance needed? (list)				
Adequate equipment redundancy? *(*see note below)*				

**Adequate redundancy means that each critical component of the treatment train is backed up by other similar components, or that the process stream can be redirected in such manner that treatment may continue without significant interruption, despite the "out-of-service" status of a particular piece of equipment or unit process. Depending on the piece of equipment, this could mean having a second pump in storage on-site or maintaining the telephone number of a rental company or contractor that could provide the equipment in an emergency situation.*

2. *Pumps and Pumping Equipment*

Complete the following chart with information about each pump used in conjunction with the groundwater system. This includes raw water pumps, finished water pumps, well pumps, booster pumps, and all other pumps used in the system *(excluding chemical feed pumps)*. If the groundwater system has more than four pumps, copy this page and complete the chart for all source pumps.

	Pump __	**Pump ___**	**Pump ___**	**Pump ___**
Pump application (e.g., supply, booster)				
Pump type (e.g., submersible, line shaft)				
Status (active, inactive, or standby)				
Age				
Method of control (e.g., manual, timer, pressure-level, or other)				
Current condition of pump (as designed, unreliable, out of service, needs replacement, new, or other)				
Condition of electrical power and controls (as designed, unreliable, out of service, needs replacement, new, or other)				

	Pump __	**Pump ___**	**Pump ___**	**Pump ___**
Hours per day of operation (average and maximum)				
Capacity (design and current, in GPM)				
Provided with adequate appurtenances (e.g., isolation valves, master meter, blow-off, check valve)				
Date of last pump test				
Results of last pump test				
List recent maintenance performed				
Describe rehabilitation or maintenance needed				
List reasons why pump is performing at less than rated figures				

3. *Corrective and Emergency Maintenance*

Complete the following table to describe any unplanned corrective or emergency maintenance procedures, requiring more than four person/hours labor, performed on the system's wells during the last year.

Maintenance procedure performed	Cause of problem	Cost of replacement parts	Cost of contract assistance (if any)

1. Are all conditions requiring corrective and/or emergency repairs, and an explanation of their probable causes, recorded in a timely fashion in the plant's operating log? Give one or two examples.

2. Did any of the conditions cited in the previous table(s) result in violations of the Safe Drinking Water Act? If so, explain, with dates. (Use separate sheets if necessary.)

3. Does the facility take into account the previous year's record of unplanned corrective or emergency repairs made to pumps/pumping equipment, and their labor and spare parts costs, into cost estimating for the next budget cycle? Is there an historical record of such repairs, so that trend charts for emergency spending may be developed? (e.g., if the facility has, on average, spent $15,000 on corrective or emergency repairs made to the facility's pumps in the previous few years, is $15,000 built into the budget for the next year?)

4. Are there any conditions that exist **right now** which you consider potential emergencies? Might any of these conditions lead to violations of the Safe Drinking Water Act or to catastrophic failure of an essential component of the system or to accident hazards to staff or the public?

5. Have any critical emergency repairs been stalled or severely slowed down by the absence or scarcity of necessary spare parts? If so, what precautions have been taken to protect against this situation in the future?

B. Surface Water Systems

1. Basic System Information

Complete the following chart with information about each surface water source used by the system. If the system has more than four sources, copy this page and complete the chart for all sources.

	Source __	**Source __**	**Source __**	**Source ___**
Surface Physical Components				
Type (river, spring, lake, etc.)				
Number of intake points				
Intake screened? (yes or no)				
Water Quality				
Potential contamination sources (yes or no) or subject to flooding (yes or no)?				
Source water protection plan? (yes or no)				
Raw water quality concerns (list)				

	Source __	Source __	Source __	Source ___
Water Quantity				
Permitted withdrawal (see permit conditions)				
Actual withdrawal: ▪ Average withdrawal (daily) *and* ▪ Maximum withdrawal (daily)				
Minimum stream flow during drought conditions				
Treatment System				
Describe the treatment process. (Diagram on a separate sheet if necessary.)				
Name and age of major components: ▪ basins, ▪ filters, ▪ chlorinators, aerators, ▪ pumps, ▪ chemical feed equipment, ▪ etc.				

	Source __	Source __	Source __	Source ___
Treatment Systems (cont)				
Production capacity, GPM or MGD				
What is current maximum production capacity? Does this treatment capacity meet highest demand?				
How many hours/day must the plant operate to meet typical demand?				
Does the treatment process produce finished water in 100% compliance with the SDWA? If not, why not?				
Are written Standard Operating Procedures available for all treatment processes?				

	Source __	**Source __**	**Source __**	**Source ___**
Treatment Systems (cont)				
Is treatment plant(s) subject to flooding?				
General treatment plant(s) condition: ▪ corrosion? ▪ leaks? ▪ electrical or mechanical defects? ▪ dirt, grime or chemical spillage? ▪ paint? ▪ other?				
Adequate containment provided for chemical spills? (yes or no)				
Adequate equipment redundancy? *(*see note below)* Needs?				
Alarm systems adequate? (SCADA, alarm recording telephone, etc.)				

**Adequate redundancy means that each critical component of the treatment train is backed up by other similar components, or that the process stream can be redirected in such manner that treatment may continue without significant interruption, despite the "out-of-service" status of a particular piece of equipment or unit process. Depending on the piece of equipment, this could mean having a second pump in storage on-site or maintaining the telephone number of a rental company or contractor that could provide the equipment in an emergency situation.*

2. *Pumps and Pumping Equipment*

Complete the following chart with information about each pump used in the surface water system. This includes raw water pumps, finished water pumps, well pumps, booster pumps, and all other pumps used in the system *(excluding chemical feed pumps)*. If the system has more than four pumps, copy this page and complete the chart for all source pumps.

	Pump ___	**Pump ___**	**Pump ___**	**Pump ___**
Pump application (e.g., supply, booster)				
Pump type (e.g., submersible, line shaft)				
Status (active, inactive, or standby)				
Age				
Method of control (e.g., manual, timer, pressure-level, or other)				
Condition of electrical power and controls (as designed, unreliable, out of service, needs replacement, new, or other)				
Hours per day of operation (average and maximum)				
Capacity (design and current, in GPM)				
List reasons why pump is performing at less than rated figures				

	Pump __	**Pump __**	**Pump __**	**Pump __**
Provided with adequate appurtenances (e.g., isolation valves, master meter, blow-off, check valve)				
Date of last pump test				
Results of last pump test				
Current condition (as designed, unreliable, out of service, needs replacement, new, or other)				
List recent maintenance performed				
Describe rehabilitation or maintenance needed				

3. *Corrective and Emergency Maintenance*

Complete the following table to describe any unplanned corrective or emergency maintenance procedures requiring more than four person/hours labor performed on the system's surface water sources during the last year.

Maintenance procedure performed	Cause of problem	Cost of replacement parts	Cost of contract assistance (if any)

1. Are all conditions requiring corrective and/or emergency repairs, and an explanation of their probable causes, recorded in a timely fashion in the plant's operating log? Give one or two examples.

2. Did any of the conditions cited above in the previous table(s) result in violations of the Safe Drinking Water Act? If so, explain, with dates. (Use separate sheets if necessary.)

3. Does the facility take into account the previous year's record of unplanned corrective or emergency repairs made to pumps/pumping equipment, and their labor and spare parts costs, into cost estimating for the next budget cycle? Is there an historical record of such repairs, so that trend charts for emergency spending may be developed? (e.g., if the facility has, on average, spent $15,000 on corrective or emergency repairs made to the facility's pumps in the previous few years, is $15,000 built into the budget for the next year?)

4. Are there any conditions that exist *right now* which you consider potential emergencies? Might any of these conditions lead to violations of the Safe Drinking Water Act, catastrophic failure of an essential component of the system, or accident hazards to staff or the public?

5. Have any critical emergency repairs been stalled or severely slowed down by the absence or scarcity of necessary spare parts? If so, what precautions have been taken to protect against this situation in the future?

<u>Summary of System Sources and Treatment</u>

This section is meant to help you evaluate and prioritize the challenges to your system's sources and treatment capabilities. Looking back at the information you provided in preceding sections and your knowledge of the system, summarize defects and deficiencies noted above and then prioritize them according to their justified need. Using the ranking system provided below, complete the table found on the following page.

*Priority Ranking System**

1 =	Issue presents an imminent threat to public health or safety <u>OR</u> issue presents a current Safe Drinking Water Act compliance problem
2 =	Issue presents a potential or future threat to public health or safety <u>OR</u> issue presents a potential or future Safe Drinking Water Act compliance problem
3 =	Issue impacts negatively or could impact negatively system performance or efficiency, but does not present an immediate threat to public health, safety, or compliance with the SDWA
4 =	Issue presents a future threat to the long-term capacity of the system

*Note: Although an issue might be categorized as a "3" or "4" priority today, you can be sure that it will become a higher priority at some point in the future. It is wise to fix these problems sooner rather than later, when more may be at stake and it might cost more to fix.

Priority-Setting Worksheet for Issues Related to Sources and Treatment

ACTION ITEM	PROBLEM / CONCERN	CORRECTIVE ACTION REQUIRED	COST	OTHER RESOURCES REQUIRED	PRIORITY *(see ranking system)*

Priority-Setting Worksheet for Issues Related to Sources and Treatment

ACTION ITEM	PROBLEM / CONCERN	CORRECTIVE ACTION REQUIRED	COST	OTHER RESOURCES REQUIRED	PRIORITY *(see ranking system)*

C. Storage

Too often, finished water storage facilities become a forgotten component of small town water systems. However, these facilities' vulnerability to corrosion and damage from weather—particularly for elevated storage tanks and other above ground installations—makes them particularly susceptible to deterioration and failure. This is especially troubling because storage systems are hugely expensive to replace. Yet many communities fail consistently to invest appropriately in the care and preservation of their standpipes, or elevated storage tanks, until, too late, they discover that corrosion has set in and the facility is beyond repair. Inspections, both inside and outside of tanks, must be a regular feature of storage system maintenance.

Complete the following chart to indicate the status of each major component of the storage system.

Name or other identification of component	__________	__________	__________	__________
Physical Components				
Type (elevated, ground-level, etc.)				
Age				
Capacity				
Type of material (steel, concrete, etc.)				
Visible corrosion or other deterioration (yes or no)?				
Type of level control used for storage tank? (e.g., pressure controls, level controls)				
Level controls adequately maintained? (*see note #1 below*)				

NOTE #1: Level controls should be inspected and operated where applicable and calibrated once a year, if necessary. Sensors inside the tank may require more frequent inspections or repairs. Level controls should be verified by a second means, such as a pressure gauge that is read and correlated to water depth. If that depth does not equal the level gauge reading, then a problem may exist and must be corrected.

Name or other identification of component	____________	____________	____________	____________
Physical Components (cont)				
Number of hours of storage (peak demand and average daily demand)? (*see note #2 below*)				
Is there an adequate low-pressure alarm system (yes or no)? (*see note #3 below*)				
Routine Operations and Maintenance				
Date of last internal inspection (*see note #4 below*)				
Date of last external inspection (*see note #4 below*)				
Corrective Maintenance				
Recent maintenance (type and date)				
Rehabilitation/ maintenance needed				

NOTE #2: Optimally, the system should maintain a supply adequate to meet a 24-hour demand.

NOTE#3: An adequate alarm system should be in place to prevent low pressure problems in the distribution system. The alarm should transmit a signal to a location that will insure a timely response.

NOTE #4: The recommended frequency for an inspection of the interior of a metal tank is once every 5 to 8 years, depending on the nature of the environment where it is located. For example, a metal tank located in a corrosive environment (e.g., near a salt water body) will likely require inspection more frequently than a similar tank located in a less corrosive environment. The interior should also be inspected whenever the tank is drained for any other reason. If an inspection of a tank in the system *has not been* conducted in the last 5 to 8 years, the facility should consider including a tank inspection in the upcoming year's scheduled activities. Informal inspections of the exterior of the tank, from a practical standpoint, should be conducted on a monthly basis, or more frequently, if problems are suspected. The inspector should look for signs of leaks, corrosion or vandalism.

D. Distribution Systems

Pipes and valves allow the conveyance of finished (or "potable") water from storage systems to consumers. Normally, almost all of a distribution system is below ground, out of sight. When human resources are in short supply, the distribution system is easily ignored and is often the last component to be serviced; however, this part of the system is, obviously, critical to the adequate and uninterrupted flow of water to customers. And, when the distribution system itself contributes unwanted characteristics to the water—turbidity, unpleasant colors or tastes, possibly dangerous inorganic constituents—relations with customers can quickly become strained, and the public health threatened. Thus a regular schedule of valve exercise, pipe inspections and cleaning, chemical analysis of water taken from remote sampling points, and replacement of aging mains and laterals characterizes every well maintained water distribution system.

1. Piping

Complete the following chart for all major piping used in the distribution system. Duplicate this page if necessary.

Physical Components				
Material type (ductile iron, PVC, steel, etc.)				
Diameter(s)				
Approximate total mileage, or footage				
Ages, newest to oldest				
Routine and Corrective O&M				
Frequency of reported leaks				
Problems corrected during last 12 months				
Problems still uncorrected				

1. What is the minimum operating pressure normally found in the distribution system?* ____
   Where found? ____

   What is the maximum operating pressure normally found in the distribution system? ____
   Where found? ____

   Are there any places in the system where operating pressure is consistently below 35 PSI?   If "yes," where?______________________________

   Is the system capable of maintaining 20 PSI even when stressed by worst-case scenarios, such as major firefighting? ______________________

   Has a hydraulic model of the distribution system ever been commissioned? When? What were the results?
   ____
   ____
   ____

*It is desirable to balance system pressures as closely as possible and to keep them in balance during periods of both high and low consumption. Areas of greatly varying pressures may indicate faulty pressure control valving, large leaks, or poor system design. Zones of low pressure above all may indicate an inability to fight fires effectively. Chronic pressure variations greater than 20 percent indicate the need for a computer generated hydraulic model of the system. Adequate system maintenance, particularly of pressure balancing equipment like valves, is a must.
**Taken from the* "Ten State Standards," Recommended Standards for Water Works*, published by the Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 1997 Edition.*

2. When was the distribution system last flushed? Is there a set of standard operating procedures for main and lateral flushing? Have there been a significant number of customer complaints about cloudy or rusty water?
   ____
   ____
   ____
   ____
   ____

2. Valves

Complete the following chart for all major valves in the distribution system. Duplicate this page if necessary.

	Type of valve (gate, pressure regulating, altitude, relief, blow-off, hydrant, etc.) ______	**Type of valve** ______	**Type of valve** ______	**Type of valve** ______
Diameter range of gate valves				
Pressure ranges of regulating valves				
Number of valves				
Ages (oldest to newest)				
Number of valves currently not functioning				
Problems corrected during last 12 months				
Problems still uncorrected				
Additional valves needed				

1. Briefly describe below the schedule for exercising system valves, identify any valves which cannot be exercised, and describe why.*

____
____
____
____
____
____

2. Describe below the schedule for flushing hydrants and whether the water used for flushing is metered.

____
____
____
____
____
____

**Flushing and regular valve exercise are two important tasks which must not be ignored by the distribution system operator. Valves are quick to bind up from corrosion or encrustation if left too long without being opened and closed on a regular schedule. Too often major leaks cannot be effectively isolated because flow control valves are frozen into their open position by corrosion or encrustation. Regular flushing of mains and laterals is done to reduce sediment build-up and rust, both of which compromise the aesthetic quality of the water and invariably lead to customer complaints.*

3. Pumps and Pumping Equipment

Complete the following chart with information about each pump used in the distribution system. If the distribution system has more than six pumps, copy this page and complete for all pumps.

	Pump ___	**Pump ___**	**Pump ___**	**Pump ___**	**Pump ___**	**Pump ___**
Pump application (raw water supply, well, booster etc.)						
Type (line shaft, submersible, etc.)						
Status (active, inactive, standby etc.)						
Age						
Method of control (timer, float switch, pressure, manual other)						
Rated capacity, GPM						
Hours/day in operation: average maximum						
Date of last pump test						
Results of last pump test						

	Pump ___	Pump ___	Pump ___	Pump ___	Pump ___	Pump ___
Condition of control panels, power supply: (as designed, unreliable, out of service, needs replacement, etc.)						
Current pump condition (as installed, new, unreliable, out of service, needs replacement, etc.						
Adequate appurtenances? (isolation valves, master meter, blow-off, check valve, etc.)						
Recent maintenance performed						
Rehab or maintenance still needed						
Is pump performing adequately? Why not?						

4. Water Meters

As typical meters age they tend to under-register, so that it becomes cost effective to replace them on a regular basis. Generally, typical water meters begin to show enough under-registration after 12-15 years that replacing them becomes a good investment. For example, assume a 10 year-old meter measures only 9,000 gallons for each 10,000 gallons passing through it, and water is billed to that meter at a rate equal to $40 per 10,000 gallons. Each 1,000-gallon unit of water is therefore worth $4. The value of the lost water is $48./year; the cost of a new residential (⅝ or ¾ inch) meter is usually under $100. The purchase of new meters would, in this case, be equal to an almost 33 percent yield on investment! (Payback in two years, profit in the third.) Master meters are often dependent on electronics (sonic devices, etc.) and should be calibrated by an expert at least every six months. This service is usually rendered by a contractor.

1. Number of metered connections:
   Residential_____; Commercial_____; Industrial_____.

2. Size of meters (in inches or fractions): Residential_____;
   Commercial (size range)______________;
   Industrial (size range)_______________.

3. Average age of meters:
   Residential_____; Commercial_____; Industrial_____.

4. Describe below the strategy used for the replacement of meters once they have reached their useful service life. How many were replaced last year?
   ____
   ____
   ____
   ____
   ____
   ____

5. Describe below the strategy used for testing and calibrating system master meters (raw water transmission, purchased water, treatment-to-storage, storage-to-distribution, any others).
   ____
   ____
   ____
   ____
   ____
   ____

5. Corrective and Emergency Maintenance

Complete the following table to describe any unplanned corrective or emergency maintenance procedures requiring more than four person/hours labor performed on the system's distribution system during the last year.

Maintenance procedure performed	Cause of problem	Cost of replacement parts	Cost of contract assistance (if any)

1. Are all conditions requiring corrective and/or emergency repairs, and an explanation of their probable causes, recorded in a timely fashion in the plant's operating log? Give one or two examples.

2. Did any of the conditions cited above in the table result in violations of the Safe Drinking Water Act? If so, explain, with dates. (Use separate sheets if necessary.)

3. How specifically does the annual record of unplanned corrective or emergency repairs, and their labor and spare parts costs, enter into cost estimating for the next budget cycle? Is there an historical record of such repairs, so that trend charts for emergency spending may be developed?

4. Are there any conditions that exist **right now** which you consider potential emergencies? Might any of these conditions lead to violations of the Safe Drinking Water Act, or to catastrophic failure of an essential component of the system, or accident hazards to staff or the public?

5. Have any critical emergency repairs ever been stalled or severely slowed down by the absence or scarcity of necessary spare parts? If so, what precautions have been taken to protect against this situation in the future?

Summary of System Storage and Distribution

This section is meant to help you evaluate and prioritize the challenges faced by the system's storage and distribution capabilities. Looking back at the information you provided in preceding sections and what you know of the system, summarize defects and deficiencies noted above and then prioritize them according to their justified need. Using the ranking system provided below, complete the table found on the following page.

*Priority Ranking System**

1 =	Issue presents an imminent threat to public health or safety OR issue presents a current Safe Drinking Water Act compliance problem
2 =	Issue presents a potential or future threat to public health or safety OR issue presents a potential or future Safe Drinking Water Act compliance problem
3 =	Issue impacts negatively or could impact negatively system performance or efficiency, but does not present an immediate threat to public health, safety, or compliance with the SDWA
4 =	Issue presents a future threat to the long-term capacity of the system

*Note: Although an issue might be categorized as a "3" or "4" priority today, you can be sure that it will become a higher priority at some point in the future. It is wise to fix these problems sooner rather than later, when more may be at stake and it might cost more to fix.

Priority-Setting Worksheet for Issues Related to Storage and Distribution

ACTION ITEM	PROBLEM / CONCERN	CORRECTIVE ACTION REQUIRED	COST	OTHER RESOURCES REQUIRED	PRIORITY *(see ranking system)*

Priority-Setting Worksheet for Issues Related to Storage and Distribution

ACTION ITEM	PROBLEM / CONCERN	CORRECTIVE ACTION REQUIRED	COST	OTHER RESOURCES REQUIRED	PRIORITY *(see ranking system)*

Overall Summary of Source Water, Treatment, Storage and Distribution (Section II)

Looking back over the two priority-setting worksheets you completed in the previous section, compile one table (provided below), which ranks all of the issues identified under the Operations and Maintenance section of this evaluation (Section II). List all of the “first priority” issues first, followed by the second-, third-, and fourth-ranked issues.

When preparing this analysis, focus on questions of basic adequacy. Is there a sufficient amount of available water, and can it be adequately treated at reasonable cost? Is there enough storage capacity, and is the distribution system in relatively good condition? And what of future needs: is the population of the user area growing faster than your system can accommodate them?

The following section is intended as the place where you, the technicians who run the system, have an opportunity to summarize the problems you face, and the equipment, personnel, and money you will need to solve them.

Overall Summary of Section II

PRIORITY (list all highest-priority issues first)	**ACTION ITEM**	**PROBLEM / CONCERN**	**CORRECTIVE ACTION REQUIRED**	**COST**	**OTHER RESOURCES REQUIRED**

Overall Summary of Section II

PRIORITY (list all highest-priority issues first)	**ACTION ITEM**	**PROBLEM / CONCERN**	**CORRECTIVE ACTION REQUIRED**	**COST**	**OTHER RESOURCES REQUIRED**

Overall Summary of Section II

PRIORITY (list all highest-priority issues first)	**ACTION ITEM**	**PROBLEM / CONCERN**	**CORRECTIVE ACTION REQUIRED**	**COST**	**OTHER RESOURCES REQUIRED**